a grounding strap to connect said conductive coating of said conductive optical mask to electrical ground;

a field emission electron source to provide an electron beam;

a charged particle beam column to deliver and scan said electron beam from said field emission electron source on a top surface of said conductive coating;

a backscatter electron detector to detect backscattered electrons from said conductive optical mask to generate a backscatter electron waveform as said electron beam scans said conductive optical mask;

a secondary electron detector to detect secondary electrons from said conductive optical mask to generate a secondary electron waveform as said electron beam scans said conductive coating; and

a processor to examine said backscatter electron waveform and said secondary electron waveform to determine construction features of said conductive optical mask.

2. A system to automatically inspect an optical mask as in claim 1 wherein said optical mask is a phase shift mask.

3. A system to automatically inspect an optical mask as in claim 1 wherein said film coating system is a sputtering system.

4. A system to automatically inspect an optical mask as in claim 1 further comprising a memory connected to each of said backscatter electron detector and said secondary electron detector to store said backscatter electron waveform and said secondary electron waveform from said conductive optical mask.

5. A method for automatically inspecting an optical mask, said method comprising the steps of:

a. applying a conductive coating to a top surface of said optical mask to produce a conductive optical mask;

b. electrically grounding said conductive coating;

c. scanning an electron beam on a top surface of said conductive coating of step b.;

d. detecting backscattered electrons from said conductive coating of step c. to form a backscatter electron waveform;

e. detecting secondary electrons from said conductive coating of step c. to form a secondary electron waveform;

f. examining said backscatter electron waveform and said secondary electron waveform from steps d. and e.; and

g. determining construction features of said conductive optical mask in response to step f.

6. A method for automatically inspecting an optical mask as in claim 5 wherein said optical mask is a phase shift mask.

7. A method for automatically inspecting an optical mask as in claim 5 wherein step a further includes the step of:

h. sputtering said coating onto said optical mask.

8. A method for automatically inspecting an optical mask as in claim 5 further including the step of:

i. storing each of said backscatter electron waveform from step d. and said secondary electron waveform from step e.]

* * * * *

9. A method of testing a semiconductor structure, comprising:

a) charging an element of the semiconductor structure;
b) applying an electric field perpendicular to a surface of the structure while charging so as to determine charging potential and polarity;
c) interrogating the structure including the charged element with a charged particle beam so as to obtain voltage contrast data for the structure; and
d) analyzing the data to determine the functionality of the element.

10. A method as claimed in claim 9, wherein the charging step a) is performed using a charged particle bean.

11. A method as claimed in claim 10, wherein the charged particle beam is an electron beam.

12. A method as claimed in claim 11, wherein the electron beam to flood an area of the structure which encompasses the element with electrons.

13. A method as claimed in claim 11, comprising using the electron beam to apply a focused beam of electrons to the element.

14. A method as claimed in claim 9, wherein the step of applying an electric field comprises providing an electrode spaced from the surface and applying a voltage between the structure and the electrode.

15. A method as claimed in claim 14, wherein the structure is positioned on a plate and the voltage is applied between the electrode and the plate.

16. A method as claimed in claim 9, comprising applying the electric field so as to charge the element with a negative potential.

17. A method as claimed in claim 9, wherein the interrogating step c) comprises scanning the charged particle bean; over the structure and detecting resulting secondary electrons so as to obtain voltage contrast data.

18. A method as claimed in claim 9, comprising obtaining the voltage contrast data in the form of an image.

19. A method as claimed in claim 9, wherein the step of analyzing the data comprises comparing the data to reference data such that newly acquired data are compared to a plurality of reference data, a defect being determined when the newly acquired data differ to all of the reference data.

20. A method as claimed in claim 9, further comprising controlling the temperature of the structure during the test.

21. Apparatus for testing semiconductor structures, comprising:

a) means for applying charge to an element of the semiconductor structure;
b) an electric field generator which applies an electric field perpendicular to a surface of the structure so as to determine the potential and polarity of the charge applied to the element;
c) a charged particle beam device for interrogating the charged element; and
d) a detector which obtains voltage contrast data from the structure on interrogation with the charged particle beam.

22. Apparatus as claimed in claim 21, wherein the means for applying charge comprises a charged particle beam.

23. Apparatus as claimed in claim 22, where the charged particle beam comprises an electron beam.

24. Apparatus as claimed in claim 21, wherein the electric field generator comprises an electrode spaced from the surface of the structure to which a voltage is applied relative to the structure.

25. Apparatus as claimed in claim 24, wherein the electrode comprises a grid.

26. Apparatus as claimed in claim 24, wherein the electrode comprises an aperture plate.

27. Apparatus as claimed in claim 24, further comprising a sample plate on which the structure is positioned, the voltage being applied between the electrode and the sample plate.

28. Apparatus as claimed in claim 27, wherein the sample plate is grounded and the voltage at the electrode is selected to determine the potential and polarity of charging.

29. Apparatus as claimed in claim 27, wherein the electrode is grounded and the voltage at the sample plate is selected to determine the potential and polarity of charging.

30. Apparatus as claimed in claim 24, wherein the voltage can be varied to determine the potential and polarity of the charge applied to the element.

31. Apparatus as claimed in claim 23, wherein the detector detects secondary charged particles from the structure arising from the interrogation with the charged particle beam.

32. Apparatus as claimed in claim 23, further comprising a display which displays the voltage contrast data.

33. A method of testing a semiconductor structure, comprising:

a) applying electron beam of relatively low energy relative to the structure to negatively charge electrically floating portions of the structures;
b) interrogating the structure including the charged portions with a charged particle beam so as to obtain voltage contrast data for the structure; and
c) analyzing the data to determine the functionality of the structure.

34. A method as claimed in claim 35, wherein the electron beam has an energy which is less than 20 V relative to the semiconductor structure.

35. A method for detecting electrical defects in a die on a semiconductor wafer, comprising:

a) applying charge to a predetermined region of the wafer such that electrically isolated structures in the die are raised to a voltage relative to electrically grounded structures;

b) probing the region so as to obtain voltage contrast data for the structures in region of the die; and

c) analyzing the voltage contrast data to detect structures at a voltage different to predetermined voltages for such structures.

wherein the step of applying charge is performed so as to apply charge to the region at a significantly lower resolution than the resolution at which the region is probed.

36. A method as claimed in claim 35 wherein step a) comprises flooding the region of the die with relatively low energy electrons.

37. A method as claimed in claim 36, wherein the flooding step applies electrons to at least a major part of the region in a single step.

38. A method as claimed in claim 35, where step b) comprises scanning a charged particle beam across the region in a series of scan lines which intersect the structures.

39. A method as claimed in claim 38, wherein the charged particle beam scans substantially less than the whole area of the region.

40. A method as claimed in claim 35, wherein step b) comprises obtaining a voltage contrast image of the region of the die.

41. A method as claimed in claim 40, wherein step c) comprises comparing the voltage contrast image to an image of corresponding structures at the predetermined voltages.

42. A method as claimed in claim 40, wherein step c) comprises comparing the voltage contrast image with an image of corresponding structures elsewhere on the wafer and determining any differences between the images.

43. A method as claimed in claim 35, comprising repetitions of steps a) –c) separated by manufacturing process steps applied to the wafer.

44. Apparatus for detecting electrical defects in a die on a semiconductor wafer, comprising:

a) means for applying charge to a predetermined region of the wafer such that electrically isolated structures in the die are raised to a voltage relative to electrically grounded structures;

b) a probe, having a significantly higher resolution than the means for applying charge, for obtaining voltage contrast data for the region of the die containing such structures; and

c) means for analyzing the voltage contrast data to detect structures at a voltages different to predetermined voltages for such structures.

45. Apparatus as claimed in claim 44, wherein the probe comprises an electron beam probe arrangement which scans an electron beam across the region of the die.

46. Apparatus as claimed in claim 44, wherein the electron beam probe also includes a detector for secondary electrons emitted from the die as the electron beam is scanned across the region.

47. Apparatus as claimed in claim 45, wherein the electron beam probe scans the beam across substantially less than the whole area of the region.

48. Apparatus as claimed in claim 44, wherein the means for analyzing voltage contrast data compares the voltage contrast data obtained from the region with voltage contrast data obtained from a corresponding region of another device.

49. Apparatus for detecting electrical defects in a device on a semiconductor wafer, comprising:

a) a charged particle beam probe for scanning a charged particle beam across a predetermined region of the surface of the device in a series of spaced scan lines so as to intersect structures in the device;

b) a secondary particle detector for obtaining voltage contrast data for the scan lines; and

c) means for analyzing the voltage contrast data to determine the presence of a structure at a different voltage to a predetermined voltage for that structure.

50. Apparatus as claimed in claim 49, wherein the means for analyzing the voltage contrast data comprises means for comparing the data with corresponding data obtained from another device so as to determine any difference there between.

51. Apparatus as claimed in claim 49, further comprising a stage for the wafer which is capable of moving the wafer relative to the electron beam probe.